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Office of the Secretary of State
1500 11th Street
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19 October 2004

Subject: Review of the Election Systems and Software (ES&S)'s Installed iVotronics, Firmware Release 7.4.5.0, in Merced, California.

Executive Summary

Michael Wagaman, from the Secretary of State and I participated in a full Logic and Accuracy (L&A) test and review of installed software used by the Election Systems and Software (ES&S)'s iVotronics Direct Recording Equipment (DRE), Version 7.4.5.0, in San Mateo, CA 13-14 Oct 2004 for the November 2004 election.

Review testing was restricted to inspecting Logic & Accuracy Test (L&A) scripts and testing iVotronics operation. The operational test included testing ballots in Spanish and American Disability (ADA) Audio ballots in both English and Spanish. The county is to complete the final, full L&A test including ballots which will cover every ballot style, in every precinct, and on the assigned precinct assigned for each DRE after we left. The final results are to be forwarded to us for a final check of the results for the full L&A.

The installed version of the software was checked and confirmed with an installation source copy provided by ES&S. The election programming was done by ES&S in Omaha and we could not access or check the election definition except by inspecting the ballot screens and performing test balloting. Some minor observations from the test that may highlight issues for voters or security features are included as an attachment but are not significant problems.

No significant problems were noted with the election definition or operation of the iVotronics for the November 2004 General Election. Some security weaknesses were identified but the active involvement of poll workers reduces the risk from exploitation by voters using the terminals. Because of the limit of review, other security considerations identified from earlier reports may be applicable but were not covered in this review.

References:

[NASED] National Association of State Election Directors (NASED), Voting Systems That Are NASED Qualified, 12-05-02 (No longer available from the NASED web site).

[ES&S-1] ES&S Manual, *The iVotronic Voting System Maintenance Manual, Version Release 7.4, Hardware Version 1.0,* July 25, 2002

[ES&S-2] ES&S Manual, *The iVotronic Voting System Poll Official's Procedure Manual: Poll Worker Activated System, Version Release 7.4*, February 14, 2003

[ES&S-3] ES&S Manual, *The iVotronic Voting System Operator's Manual, Version 7.4,* October 14, 2003

Introduction

The review was not a full certification but limited to a check and test against the iVotronic firmware Version 4.7.5.0 against the November election definition for Merced CA.

Review Process

The review consisted of:

- An inspection of the test scripts and ballot distribution of contests within the ballot layout styles for each precinct,
- Verification of installed software.
- Validation test runs made against the test scripts and specific ballot layout styles selected for size and complexity,
- Operational tests against features of the iVotronics going from polls open operations, through variation on voter interactions, to polls closing and transferring results for consolidation on the Unity 2.2 reporting components.
- Operational tests against Spanish and Audio (both English and Spanish) ballots.

As a final step, the county was to complete the full L & A based on the validated scripts for every contest and candidate in the full election and on each DRE for the precinct or precincts enabled for the November election. The consolidated results of the L & A are to be submitted to the California Secretary of State's Election Division office for verification against the predicted results from the inspection and validation run.

Test Results

The Merced November General Election supports 106 precincts with 11 ballot layouts including some split precincts. The largest ballot in terms of contests supports 26 contests with the largest precinct supporting 27 contests over two ballot splits.

For the iVotronics operation test, ballots from three styles from two precincts (two of the ballot styles defined a split ballot within the precinct) were used. The selected precincts also included the most complex mix of race options in the election.

All candidates and positions were recognized and counted correctly within the operations test. Final results were transferred via Personalized Election Ballot (PEB) unit and a second copy of the results was extracted from internal memory using the procedure to copy the Audit record from the iVotronics to the compact-flash memory card. Results from both the PEB and the Audit/compact-flash copies matched when uploaded to the Election Reporting Manager (ERM). Reports combining results from multiple iVotronic DREs supporting different precincts and Audio and non-Audio ballots were complete and gave accurate results.

Merced County was preparing the 400 plus DREs for the full L&A this week, starting on 18 Oct. During that testing, every precinct, ballot style, contest, candidate, and measure position will be exercised and tested by manual entry of votes on every DRE to be used in the election. The results are to be sent to us for a final review and check.

During the operational test, each of the non-audio ballots (those involving only touch screen operations) was subjected to a range of tests involving voter responses that have resulted in anomalous results in other systems. These involve:

- touching different parts of the screen than the designated choice selection 'button' marked on the screen,
- double and rapid tapping of the screen on or around the 'buttons' and other parts of the screen,
- sliding from one part of the screen to another crossing 'button' and non-'button' areas, and
- attempting to access supervisory functions while in voter access mode.

The design was resistant to 'false selections', except for the sliding finger test. However, the design of the final review screen allowed for a 'false selection' to be detected and corrected. It

responded to similar 'false selections' in a manner that was unmistakable and required confirmation from the voter. Details on this test and the type of response encountered are provided in Attachment B.

Security Observations

(This review was not a full examination and, as a result, the following observations are only for those issues involving direct operation of the iVotronics in voting. The election management system, Unity 2.2, was certified prior to the attention currently being given to security issues and its operation was not part of this review.)

The operational mode selected for this election and used during L&A is Poll Worker Activated. In this mode, the PEB is only handled by the poll worker. The PEB containing the ballot definition is inserted by the poll-worker, the appropriate ballot style selected, and the PEB removed. The voter can not vote until the PEB is removed. The interface on the PEB is an infra-red link designed so that the PEB has to be inserted to use in a fashion that should prevent an external infra-red signal from affecting the system. In addition, the link is only active if a special magnetic field built into the PEB is detected. Access to supervisory functions required the supervisor PEB be inserted and present as well as the use of access codes. No information was provided on whether there is any encryption or authentication on this link. [redacted]

The iVotronics DRE is not connected to anything during the actual voting, excepting only a possible AC adapter connection should a battery not be fully charged. Without the AC adapter, the RS232 modem port and compact-flash memory slot should be secured with a sealable panel. With the AC adapter attached, the RS232 modem port and compact-flash card are accessible to the voter and would need to be constantly monitored by poll workers.

[redacted]

Little information was available during this review on encryption or authentication on the compact-flash disk, PEB, or RS232 printer/modem connection. There is some authentication going on based on the election and terminal assigned.

Conclusion

No significant problems were noted with the election definition or operation of the iVotronics for the November 2004 General Election. Some security weaknesses were identified but the active involvement of pollworkers reduces the risk from exploitation by voters using the terminals. Because of the limit of review, other security considerations identified from earlier reports may be applicable but were not covered in this review.

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Sincerely,

Steven V. Freeman

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Two Attachments:

A. Hardware Description with a list of the test configuration components.
B. Test Observations

Attachment A

Hardware Descriptions

ES & S iVotronics DRE

The iVotronics system components consist of

- Red supervisor terminal(s).
- Red supervisor Personalized Electronic Ballots (PEBs).
- Blue voting terminal(s).
- Blue voter Personalized Electronic Ballots (PEBs).
- Communication Pack(s) with a printer and optional modem.
- PEB reader for transferring PEB data to a PC.
- AC adapter used to recharge batteries in the terminal.

The iVotronics terminals are sealed units with only a single button used to cast a ballot. iVotronic terminals supporting ADA Audio ballots have three additional buttons, two scroll buttons going Up or Down, and a Selection button. The PEB is also sealed and is too large to easily put in a pocket. The PEB communicates with terminal using an infra-red link designed so the device has to be seated with a special magnetic signal/signature before data transfer will be allowed. The firmware is installed with a compact-flash card or from a previously installed copy on a supervisor terminal using a PEB dedicated to loading the PEB. The compact flash slot, located on the top edge of the terminal has a security door that can be closed and sealed. The standard compact-flash card also stores the bit-mapped images for the device screens and must be present during voting. Both the PEB and the compact-card may be used to store results once the election is done to transfer results to the Unity Election Reporting Manager for consolidation and reporting. The compact-flash can be used to upload audit trail data, one of a redundant set of copies of the results.

During voting, the terminal may be configured to use either Poll worker or Voter controlled voting. In the first, the poll worker retains control of the PEB and the PEB is removed from the device once the ballot is loaded. In the Voter controlled voting, the PEB prepared and handed to the voter by the poll worker using a supervisor terminal who, in turn, inserts the PEB. For this county, the Poll worker controls the voting.

The Communication pack consists of a rechargeable AC/battery power supply, the modem, and the printer in a briefcase shaped case. The modem is used to interface the printer and the terminal using a direct RS232 ribbon cable. The modem can also be used to forward results by telephone. Other than using the report printer, the modem is not used for this review. The case also holds for transporting PEBs and AC adapter.

Test Configuration

1. Server: access to the Unity server/workstations was limited and not a formal part of this review.
    a. Installed Unity modules:
        i. Audit Manager 7.0.0.0
        ii. Election Data Manager 7.1.1.1
        iii. Hardware Program Manager 3.6.0.0
        iv. Data Access Manager 4.3.0.0
        v. Election Report Manager 6.3.2.11

        Note: Unity is purchased and installed by module. The iVotronics Image Manager was not acquired and installed, therefore, ES&S provides the election programming service provided by that module. It was not clear to what extent, other than ERM, how much these modules are actually current, used, and depended on by this county.

2. Voting Units
    a. iVotronics Units, Version 7.4.5.0 Firmware
        i. S/N V5121702, non-ADA Audio
        ii. S/N V5129023, ADA Audio
    b. PEB
        i. S/N PS147880
        ii. S/N PS154028

Attachment B

Test Observations.

The following are observations from the operations test using the two precincts and three ballot styles selected:

1. Documentation for the system refers to several options or alternative behaviors which are defined during the election definition. The list of the options selected was not available for the testing, since it was programmed by ES&S in Omaha.
2. The zero report is obtained by connecting the Communications pack after the polls opened. The Communication pack needs to be removed before voters start using the terminal.
3. A copy of the compact flash contents was obtained before ballots were cast and after the polls closed. The compact flash contained a copy of the firmware and other files providing the screen images used by the device. The two copies were compared and there were no changes in the contents between opening and closing.
4. The firmware on the compact flash memory card was compared to the build reference copy and confirmed as the Firmware release 7.4.5.0.
5. The Audit record was downloaded to the compact-flash and confirmed by comparison with the copy of the compact-flash from the opening of the terminal. The updated flash shows the same firmware and other static files.
6. The PEB must be removed before voting begins. Attempts to leave it in result in no response when the voter attempts to select candidates.
7. The overvote prevention is set as an option In the election setup.
    a. For this test, an attempt to overvote on a Vote for One race resulted in the previous selection being reset and the last selection being accepted.
    b. An alternative is to require the vote to deselect the previous selection before a new selection can be made.
    c. In the Vote for Three, a message appears if an attempt is made to overvote requesting the voter to deselect an existing selection before another candidate may be selected. In the Vote for Three, the automatic reset does not occur because the system can not tell which of the prior selected candidates is to be reset.
8. The screen keyboard displayed to enter write-in candidate names contains no punctuation except a space and no numerical digits.
9. During the operations test, candidates were selected in each race and deselected/reselected
    a. While still on the screen showing the contest.
    b. After leaving the contest and returning.
    c. From the review screen

    All candidates were correctly deselected and final selection accurately voted.
10. On the review screen, if the voter selects a contest to change, the voter is returned to the specific contest but returns back to the review screen once the new selection is made.
11. Each contest and review screen was checked for hidden 'hot' spots by tapping or touching at ½" intervals over the entire screen. No 'hot' spots found except for designated selection buttons.
12. Touching the screen, then sliding the finger resulted in selection/deselection occurring without the finger entering the selection button 'hot' spot.
    a. If the slide was on the line for the selection button, the selection was for the candidate/choice on the right side of the screen on that line.
    b. If the slide is vertical, the selection/deselection was unpredictable.
    c. On the review screen, the slide behaved the same but the selection/deselection always kicks into the contest to be changed allowing the voter to recognize and correct what is being done.
13. Attempted to double tap on critical buttons such as the "NEXT" button. The double tap was resisted; selecting a button takes a deliberate touch with a slight delay before responding.

14. If a PEB is reinserted before the ballot is cast, a message is presented asking if the voted ballot is to be cast or whether a new ballot is to be selected.
15. Removed the compact-flash while screen is active. System locked up and couldn't reset or restart until a technician reset the terminal.
16. One of the initial PEBs was not recognized. The terminal had been reset and the logic recognized that the PEB was no longer valid.